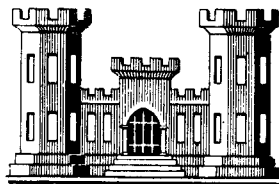


POPPONESSET BAY

MASHPEE AND BARNSTABLE

MASSACHUSETTS

SURVEY REPORT



**DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
WALTHAM, MASS.**

MAY 1972

39

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OBLIQUE VIEW OF POPPONESSET BAY

SYLLABUS

Popponesset Bay is located in the towns of Mashpee and Barnstable, Massachusetts, on the southerly shore of the arm of Cape Cod. It is a natural tidal lagoon separated from Nantucket Sound by a low, one-mile long unstable barrier beach. The only entrance is a natural migrating inlet now located between the northeasterly end of the barrier beach, and Meadow Point on the mainland. A meandering natural channel in the entrance, shifting shoals, shallow depths in the connecting waterway and throughout the bay present navigation difficulties for existing and future recreational craft.

The Division Engineer has studied the navigation problems in Popponesset Bay and has considered two plans of improvement to correct these problems. He finds that the benefits, resulting from the most favorable plan, which would provide a stabilized inlet; rebuild the barrier beach; and dredge interior navigation channels and anchorages for the existing and prospective recreational fleet, would be insufficient to justify the work. He therefore recommends that no Federal navigation improvements be undertaken in Popponesset Bay at this time.

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DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

IN REPLY REFER TO:

NEDED-R

26 May 1972

SUBJECT: Survey of Popponesset Bay,
Mashpee and Barnstable, Mass.

HQDA (DAEN-CWP-D)
WASH DC 20314

AUTHORITY

1. This report is submitted in compliance with Section 304 of the River and Harbor Act, approved 27 October 1965 (Title I, Public Law 89-298), as follows:

"The Secretary of the Army is hereby authorized and directed to cause surveys to be made at the following localities and subject to all applicable provisions of Section 110 of the River and Harbor Act of 1950,..... Popponesset Bay, Mass...."

2. The Chief of Engineers assigned preparation of the report to the New England Division Engineer on 10 November 1965.

PURPOSE AND EXTENT OF STUDY

3. The study was made to determine the need and economic feasibility of providing an adequate navigation channel from Popponesset Bay to Nantucket Sound, a stabilized inlet protected by jetties, and interior navigation channels and anchorages throughout Popponesset Bay.

4. A public hearing was held on 21 May 1969, in Mashpee, Massachusetts to obtain information concerning the desires and

need for improvements and to give the people in both communities an opportunity to present their views. The information obtained is described under "IMPROVEMENTS DESIRED", Paragraph 17. All Federal, state and local agencies, as well as others having an interest in the improvements, have been consulted during the course of the study. Their views are included in the text and in Appendix A.

5. Available charts, maps, hydrographic surveys and other related reports of the area were utilized, as well as aerial photographs flown specifically for the study. Technical advice and assistance were provided by the Coastal Engineering Research Center, U.S. Weather Bureau, U.S. Coast and Geodetic Survey, U.S. Coast Guard, U.S. Public Health Service, the U.S. Fish and Wildlife Service and affiliates, and the Environmental Protection Agency.

DESCRIPTION

6. Popponesset Bay is located on the south shore of Cape Cod, in the towns of Mashpee and Barnstable, Massachusetts (Barnstable County). It is a shallow, natural salt water lagoon about 665 acres in area, and includes Popponesset Creek, Ockway Bay, Mashpee River, Shoestring Bay, Santuit River and Pinquisset Cove. It is bordered on the west by the town of Mashpee, on the northeast by the town of Barnstable and on the southeast by Nantucket Sound. It is located 10 miles west of Hyannis, 60 miles southeast of Boston, and 240 miles east of New York City.

7. The lagoon is separated from the sound by Popponesset Beach, a low narrow baymouth bar almost one mile long, extending in a northeasterly direction from the headland at Popponesset. The bar is almost devoid of sand dunes and indigenous beach grass and is nourished by littoral drift from the bluffs to the southwest. The width of the barrier beach is generally about 250 feet and widens to about 500 feet where it connects to Thatch Island, near the northeasterly extremity.

8. Popponesset Bay Inlet is presently located at the northerly tip of the barrier beach between Thatch Island and Meadow Point. The controlling depth is about 1 1/2 feet, at mean low water, over an offshore bar directly in front of the inlet. The area within the bay is generally shoal throughout, except for a six foot deep channel in Popponesset Bay and Creek and natural channels at the mouth of the Santuit River. The mean tidal range is 2.3 feet in the bay and 2.5 feet at the Cotuit Highlands, near Cotuit Bay. The unstabilized inlet allows a considerable amount of sand to enter the bay, resulting in shoaling of the natural navigation channels. In addition, sand is also washed over the low barrier beach during storms, which shoals existing channels and covers shellfish beds. The locality is shown on U.S. Coast and Geodetic Survey Charts 1,209 and 259 and on the Cotuit, Massachusetts Quadrangle of the U.S. Geological Survey Maps.

TRIBUTARY AREA

9. The Town of Mashpee was settled in 1660 by Richard Bourne, who also christianized many of the Indians. Hunting and fishing were the chief occupations of the inhabitants, until 1834 when employment in cranberry bogs became the chief occupation. Today, Mashpee is principally a summer resort community with some of its economy sustained by cranberry bogs owned by outside interests, fishing, and Otis Air Force Base, part of which extends into the northwest sector of the town. There are no manufacturing firms, per se, reported in Mashpee. Between 1960 and 1970 the population increased from 867 to 1,288 for an increase of 48.6%.

10. Barnstable was settled in 1638 by a band of pioneers who were attracted to the area by the great marshes that yielded an abundance of salt hay for their cattle. A trading establishment was set up in 1700, which developed into a commercial exchange dealing in codfish caught on the Grand Banks, and rum and molasses made in the West Indies. By 1800, Barnstable was prospering from a general coastal trade and the northwest fur trade. Today, Barnstable's main economic interests are centered in

its attraction as a summer resort and place of summer residences. The wholesale and retail trade industry forms the basis of the town's economy. The population increases sharply in the summer and employment in the wholesale and retail trades, as well as the service industries, show characteristics of a resort center. In 1964, 18 manufacturing companies employed 368 people, with an annual payroll of \$1,385,000. Concerns employing over 20 people include a newspaper, two candle companies, a yacht building company and an electrical switch company. Between 1960 and 1970 the population increased from 13,465 to 19,842 for an increase of 47 4%.

11. Both towns are presently undergoing accelerated land development for residential housing. Concomitant with this is the development of shopping centers and other service connected industries. The area is served by excellent highways. Bus service is available from the major cities and commercial and private air service is available at Hyannis Municipal Airport, about 11 miles east of the study area. In 1968, train freight service and summer passenger service was available to Barnstable only on a very limited basis.

BRIDGES

12. The only bridge in the study area is a small narrow, wooden, fixed highway bridge connecting the northwesterly end of Popponesset Island with the mainland. The deck and roadway is supported by five closely spaced timber pile bents that restrict navigation under the bridge to very small outboard motor boats and row boats.

PRIOR REPORTS

13. There are no previous Corps of Engineers reports concerning Popponesset Bay.



POPPONESSET CREEK BRIDGE - July 1969, Looking northeasterly. Wood highway bridge connecting Popponesset Island to the mainland.

OTHER IMPROVEMENTS

14. The Commonwealth of Massachusetts dredged a navigation channel from the inlet up to an anchorage area in Shoestring Bay in 1916. The sand material was spoiled on the westerly shoreline. No costs are available. Another channel was dredged in Popponesset Bay in 1936. No records are available. In 1958, stone groins and a seawall were constructed along Meadow Point by the Commonwealth to rebuild the shoreline that was damaged by Hurricane Carol in 1954. Total cost was \$138,000. In 1961 the Commonwealth also dredged a channel from the inlet to Popponesset Creek and northward to the highway bridge at a cost of \$81,200. All of the above improvements except the seawall and groins would be incorporated into any future Federal navigation project.

TERMINAL AND TRANSFER FACILITIES

15. There are no terminal or transfer facilities in Popponesset Bay. The few shellfishermen who "bull-rake" for quahaugs and other shellfish in the bay, beach their boats at public landings and transfer the catch to small vehicles for transport to wholesale markets. There are over 70 private piers and docks located along the shoreline of the bay. The three town landings, marinas and other marine-related areas are shown on Plate 1.

IMPROVEMENTS DESIRED

16. Improvements desired by officials of the towns of Mashpee and Barnstable and by other local interests were expressed at the public hearing on 21 May 1969. The improvements are as follows:

- a. A permanent, lighted, navigable entrance channel 6 to 8 feet deep and 40 to 60 feet wide from Popponesset Bay to Nantucket Sound.
- b. A Stone jetty protecting the entrance channel.

- c. Rebuilding the entire Popponesset barrier beach to the sand spit opposite Rushy Marsh Pond.
- d. Providing interior navigation channels and anchorages throughout the bay.
- e. Consideration of public bathing areas within the bay.

17. Local interests felt that the desired improvements would provide the impetus for expanded boating activity in the bay and encourage new development of boatyards, marinas, commercial shellfish and offshore fishery enterprises. In addition, connecting existing channels in Cotuit Bay and interconnecting waterways would provide a large inland area for safe boating when offshore conditions are unfavorable. Rebuilding the barrier beach would protect the bay from storms and afford protection to valuable shorefront real estate.

EXISTING AND PROSPECTIVE COMMERCE

18. The only waterborne commerce in Popponesset Bay is shellfish. About 6 to 9 full and part-time shellfishermen work the bay. In 1968 the estimated total value of the quahaug catch was \$15,000 and the total value of the scallop catch was \$50,000. There are also a number of recreational shellfishermen, but no monetary value is available.

VESSEL TRAFFIC

19. Vessel traffic through the existing inlet is limited to recreational boats. The number of trips are estimated to be about 2,000 for small boats and about 1,000 for medium size boats, for an estimated total of 3,000 trips per year.

DIFFICULTIES ATTENDING NAVIGATION

20. The existing inlet is unstabilized and hazardous to general navigation. The natural channel meanders seasonally and a large

offshore sand bar precludes safe passage from the bay to Nantucket Sound. The average depth of water over the bar is less than two feet at low water. Interior natural channels in the upper reaches of the bay are used as anchorages by the existing boats and passage between them by other boats is difficult. Other water areas are too shoal or have insufficient depth for general boating purposes. At least one gale with winds over 32 miles per hour can be expected each year, raising tide levels and producing large waves that overtop the low lying barrier beach. Large quantities of sand are then transported into the inlet by the waves and also carried over the barrier beach into the bay, shoaling the natural and existing navigation channels and covering valuable shellfish beds. These restrictions preclude full recreational use and marine oriented growth of the bay.

WATER POWER AND OTHER SPECIAL STUDIES

21. The waterway under study is a tidal lagoon. There are no sizeable rivers or streams that would create problems concerning water power, flood control or other related subjects.

PROJECT FORMULATION

22. In formulating the study, a minimum plan was sought which would satisfy local needs and desires, while maximizing the overall future net benefits. Consideration was given to preserving the existing marine ecology and environment and also maintaining other desirable features of the bay.

23. The plan of improvement presented by the Popponesset Bay Waterways Committee, described in paragraph 16, provided for future growth of recreational boating in the bay. Rebuilding the barrier beach would protect the bay from future storms and restore the bathing beach for local use. This plan has been considered and designated as PLAN A. Details and the cost estimate are included in APPENDIX B.

24. Because of the higher cost of construction and maintenance of PLAN A, as well as the difficulty small sail boats, without

auxilliary power, would have navigating the long channel behind the new barrier beach, an alternative plan was also considered. This plan was designated as PLAN B and consisted of a shorter barrier beach, a shorter, straight entrance channel directly into the bay, and interior channels and anchorages.

25. Both plans were studied with the desires, requests and needs of local interest in mind. Standard methods of design criteria were also applied to both plans in order to develop a sound project which would use suitable dredged material and provide maximum utilization and minimum maintenance.

PLAN OF IMPROVEMENT

26. PLAN B was selected as the plan of improvement for Popponesset Bay, because it would be more practical, as well as more economical, in providing the desires and needs of local interests. The details are shown on PLATE 1. The plan would provide the following improvements:

- a. A sand dike to elevation 12.0 feet above M. L. W., constructed over the existing barrier beach, and extending from opposite Popponesset Island to Meadow Point. The bayside slope would be 1 on 5; the seaward slope would be 1 on 10 from the crest to M. H. W., then 1 on 20 from M. H. W. to the existing bottom.
- b. An entrance channel, 100 feet wide and 6 feet deep, from the 6-foot depth in Nantucket Sound, through the barrier beach at Thatch Island, and into the bay.
- c. Two rock jetties on both sides of the entrance channel, constructed to elevation 8.0 feet above M. L. W. The northerly jetty would be 800 feet long and the southerly jetty would be 1,200 feet long.
- d. Three rock groins along the seaward side of the barrier beach, constructed to an elevation of 5.0 feet above M. L. W. and 250 feet long.
- e. A 25-acre anchorage, 6 feet deep, directly behind the barrier beach.

f. A main navigation channel, 100 feet wide, 6 feet deep, from the entrance channel up the middle of the bay to a 10 acre anchorage; then becoming 50 feet wide, 6 feet deep into the Santuit River, where it terminates at a 2 acre anchorage.

g. A channel, 100 feet wide, 6 feet deep, from the entrance channel, around Popponesset Island and joining the main Channel opposit Daniel's Island.

h. A channel 100 feet wide, 6 feet deep, from the main channel into Ockway Bay, where a 4 acre and a 5 acre anchorage, 6 feet deep, would be provided.

SHORELINE CHANGES

27. The shoreline at the mouth of Popponesset Bay has been an area of active sand movement. Prior to 1950, the sandspit, which is also known as Popponesset Beach, extended across the mouth of the bay from Popponesset to the mouth of Cotuit Bay. The barrier provided protection for the Meadow Point area as well as Popponesset Bay. Littoral drift is in a northeasterly direction and sand from the headland area of Great Neck and Popponesset Point nourished Popponesset Beach keeping it relatively stable.

28. However, over the past 25 years, groins and jetties were installed at Popponesset Point to prevent erosion of the back beach and the sand source was materially reduced. As a result, the sandspit gradually eroded away and the material moved in a north-east direction. The beach became very narrow and was breached during the 1954 hurricane. The northern half of the sandspit drifted to the Rushy Marsh Pond area and formed a peninsula. The southerly portion of the sandspit combined with Big Thatch and Little Thatch Islands. The proposed plan of improvement would not materially affect the interior shoreline of 17.5 miles but it would alter the barrier beach and shoreline to the extent shown on PLATE 1.

REQUIRED AIDS TO NAVIGATION

29. Navigation aids would consist of beacon lights and radar reflectors on the jetties and markers and buoys for the channels and anchorages in the bay. The estimated first cost is \$20,000 with annual maintenance of about \$2,000. This cost would be borne by the United States Coast Guard.

ESTIMATE OF FIRST COSTS

30. An estimate of the cost of construction of the plan of improvement selected for detailed consideration was made on the basis of soundings from the United States Coast and Geodetic Survey Charts and probings and borings taken during the study. The materials to be dredged are mostly fine to coarse sand, silty fine sand, and silt. Removal of the sand would be by hydraulic dredge with disposal on the sand dike and backbeach. The silt would be removed by clamshell or bucket dredge and disposed of in deep water at sea. All dredging would be to a depth of 6-feet below mean low water, plus an allowance of 1-foot overdepth. Side slopes would be 1 on 3 in sand and 1 on 5 in silt. No interior beaches can be constructed as all usable sand would be needed to raise the protective barrier beach.

31. Rock for the groins and inlet jetties would be obtained either from the New Bedford, Massachusetts area, or other locations within economical distance. All quantities are in terms of in place measurements. Price levels are based on May 1972 prices. The project cost includes allowances for contingencies, engineering and design, and supervision and administration during construction. The estimated cost is as follows:

PLAN B

PROJECT CONSTRUCTION COST

Federal and Non-Federal

Dredging

Sand - 420,000 c.y. @ \$3.00	\$ 1,260,000
Mud - 280,000 c.y. @ \$4.50	1,260,000

Fill

Sand Dike - 200,000 c.y (grade & shape) L.S.	20,000
Excess Sand, place on beach, 220,000 cy, no charge	--

Rock

Groins - 3,700 Tons, @ \$25.00	92,000
Jetties - 31,500 Tons @ \$25.00	790,000

Dune Grass

Planting on sand dike, 17 Acres @ \$2,000	<u>34,000</u>
	\$ 3,456,000
Contingencies	<u>520,000</u>
	\$ 3,966,000
Engineering & Design	<u>238,000</u>
	\$ 4,204,000
Supervision & Administration	<u>336,000</u>
TOTAL FIRST COST	<u>\$ 4,540,000</u>

Navigation Aids, estimated (U.S.C.G.)	20,000
Public Landings, 6 (estimated), self liquidating -	<u>40,000</u>
TOTAL PROJECT COST	<u><u>\$ 4,600,000 (1)</u></u>

(1) Excludes \$70,000 for Federal study costs.

ESTIMATE OF ANNUAL CHARGES

32. Annual charges for PLAN B have been estimated on the basis of a 50-year project life with Federal and non-Federal interest rates of 5-3/8 percent. Since the benefits derived from the improvements would accrue to recreational boating and recreational fishing, the costs for the improvements would be apportioned 50% Federal and 50% non-Federal. Local interests would be required to provide all lands, easements, rights of way, spoil areas and the public landings at their own expense. In accordance with the Federal Economy Act of 1970, local interests would also be responsible for the future maintenance of the improvements attributable to recreational navigation. The annual maintenance is estimated to be 30,000 cubic yards of dredging and 350 tons of rock. Federal and non-Federal charges are as follows:

ANNUAL CHARGES

Federal

Corps of Engineers

Interest and amortization 50% of
 $4,540,000 = 2,270,000 \times .05798 = \$ 132,000$

United States Coast Guard (Nav. aids)

Interest & amortization $20,000 \times .05798 = 12,000$
Maintenance (estimated) 2,000
 $\$ 146,000$

Non-Federal

Local Interests

Interest and amortization 50% $= \$ 132,000$
 $4,540,000 = 2,270,000 \times .05798$

Maintenance

Dredging, 30,000 cy @ \$4.00 $= 120,000$
Rock Jetties & Groins 350 tons @ \$35. $= 12,000$
Sand Dike, grade and shape L.S. $= 1,000$
TOTAL NON-FEDERAL $\$ 265,000(1)$

TOTAL FEDERAL AND NON-FEDERAL ANNUAL CHARGE \$411,000

- (1) Does not include annual charges for cost of public landings and other local costs that are self liquidating.

ESTIMATE OF BENEFITS

33. The improvements considered under PLAN B would result in annual benefits to recreational interests only. The overall benefits have been reduced to net annual values using average annual equivalents where required and are as follows:

a. Recreational Boating - Benefits for the existing and prospective recreational fleet in Popponesset Bay have been estimated on the basis of expected annual net return which the boat owners would realize if they hired their boats to others, should improvements be made. The type and size of boats expected to use the proposed improvements were determined from those presently based within the bay and those based along the coast in neighboring areas. The net return is the gain between the present return and the ideal return. Present return is based on the use the boats are enjoying at their present locations. Ideal return is expressed as a percentage of the average depreciated value of the boats comprising the recreational fleet and reflects ideal navigation conditions of the area as well as the size and type of boats. In this report, the ideal return varies from 14 percent for the popular size outboards to 7 percent for larger cruisers and auxilliary sailboats. A new type of craft called "stern drives" is also included as they are becoming more popular and now comprise 4-5 percent of the recreational type boats in a harbor. The itemized boating benefits are as follows:

1. Transferred Boats - Experience has shown that whenever navigation improvements are completed in a previously unimproved harbor, there are always a number of boats transferred to the improved harbor. Many local residents now moor their boats in nearby Cotuit Bay and have expressed their intention to base their craft in Popponesset Bay after the improvements. It is estimated that about ten boats will transfer for an annual benefit of \$2,600 as shown in TABLE 1.

TABLE 1 BENEFITS TO RECREATIONAL BOATING
TRANSFERRED BOATS

HARBOR: Popponeset Bay (Immediately After Improvements)										130 Day Season		
TYPE OF CRAFT	LENGTH (feet)	No. of Boats	DEPRECIATED	VALUE	PERCENT RETURN				VALUE	ON CRUISE		
			AVERAGE	TOTAL	Ideal	% of Ideal	Gain		\$	Avg. Days	% of Season	Value \$
			\$	\$		Pres.	Fut.					
<u>RECREATIONAL FLEET</u>												
Outboards	10-20											
Inboards	15-20	1	4,500	4,500	12	80	100	2.4	108			
	21-30	2	6,300	12,600	11	80	100	2.2	276			
	31&Up	2	18,000	36,000	10	70	100	3.0	1080			
Sterndrive	15-20											
	21-25											
Cruisers	10-20											
	21-30	3	8,300	24,900	9	80	100	1.8	450	12	9	41
	31-40	2	21,000	42,000	8	75	100	2.0	840	16	12	101
	41-50											
	51&Up											
Aux. Sail	21-30											
	31-40											
	41&Up											
Sailboats	8-15											
	16-20											
	21-25											
	26&Up											
TOTALS		10		\$ 120,000					\$2,754			-142

ANNUAL BENEFIT = \$2,754 - \$142 = \$2,612 SAY \$2,600



EXISTING MARINA - July 1969, Located in
Popponesset Creek, west of highway bridge.

2. Existing Boats - There are about 220 recreational boats, excluding row boats in Popponesset Bay. They are located along the shoreline in front of private homes, in front of town landings, in existing deep portions of the natural navigation channels and in the existing boat yard and marina. The percent return on investment for the existing boats is far from ideal because of inadequate channels and anchorages and the hazardous inlet. With the improvements, the benefits to the existing fleet would be \$20,500 as shown in TABLE 2.

3. New Boats Added - The average, national boating growth has been about 5 percent. The annual growth in New England has been up to 11 percent in some areas. It is estimated that the overall future growth in this water area will average approximately 6 percent per year during the life of the project for a total bay capacity of about 900 boats. The number of new boats is estimated to be about 650, and will be located in the new anchorages and private piers and wharfs around the interior shoreline. The annual benefit for the new boats is estimated to be \$126,500 as shown in TABLE 3.

4. Transient Equivalent - Transient boats are practically non-existent in the bay due to the treacherous existing conditions at the inlet and inadequate supporting facilities. With the proposed improvements, a large fleet of transient boats would be expected to use the waterway, many staying over on weekends and returning many times during the season. Others would be only day trippers. It is estimated that the total number of visitors would amount to about 20 seasonally based boats for an annual benefit of \$6,400 as shown in TABLE 4.

5. Reduction of Existing Boat Damages - Boat damages in the present inlet amount to about \$2,000 annually and are caused by running aground on the sand bar and shoaled channels. With the improvement, these losses would be prevented and result in an annual benefit of \$2,000.

POPPONESSET BAY

TABLE 2 BENEFITS TO RECREATIONAL BOATING

EXISTING BOATS

HARBOR: Popponeset Bay			130 Day Season									
TYPE OF CRAFT	LENGTH (feet)	No. of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			AVERAGE \$	TOTAL \$	Ideal	% of Ideal		Gain *		Avg. Days	% of Season	Value \$
						Pres.	Fut.					
<u>RECREATIONAL FLEET</u>												
Outboards	10-15	95	1,800	171,000	14	70	100	4.2	7,180			
Inboards	15-20	7	4,500	31,500	12	70	100	3.6	1,134			
	21-30	4	6,300	25,200	11	60	100	4.4	1,108			
	31& Up	2	18,000	36,000	10	60	100	4.0	1,440			
Sterndrive	15-20	15	3,750	56,250	12	75	100	3.0	1,687			
	21-25	10	6,000	60,000	11	70	100	3.3	1,980			
Cruisers	21-30	2	8,300	16,600	9	60	100	3.6	598	12	9	54
	31-40	3	21,000	63,000	8	60	100	3.2	2,016	16	12	242
Aux. Sail	21-30											
	31-40	1	21,000	21,000	8	80	100	1.6	336	16	12	40
	41&Up											
Sailboats	8-15	61	1,200	73,200	12	80	100	2.4	1,757			
	16-20	17	2,100	35,700	12	70	100	3.6	1,285			
	21-25	2	3,000	6,000	11	70	100	3.3	198	6	5	10
	26&Up	1	4,000	4,000	10	60	100	4.0	160	16	12	19
TOTAL		220		\$599,450					\$20,879			\$365
									\$20,879 - 365 = \$20,514			
									ANNUAL BENEFIT = Say \$20,500			

TABLE 3 BENEFITS TO RECREATIONAL BOATING

New Boats Added
(Maximum Growth Estimated in 50 Years)

HARBOR: Popponeset Bay									130 Day Season			
TYPE OF CRAFT	LENGTH (feet)	No. of Boats	DEPRECIATED VALUE		PERCENT RETURN				VALUE \$	ON CRUISE		
			AVERAGE \$	TOTAL \$	Ideal	% of Ideal Pres.	% of Ideal Fut.	Gain		Avg. Days	% of Season	Value \$
RECREATIONAL FLEET												
Outboards	15-20	338	2,400	811,200	14	0	100	14	113,570	--	--	
Inboards	15-20	26	4,500	117,000	12	0	100	12	14,040	--	--	
	21-30	20	6,300	126,000	11	0	100	11	13,860	--	--	
	31&Up	7	18,000	126,000	10	0	100	10	12,600	--	--	
Sterndrive	15-20	32	3,750	120,000	12	0	100	12	14,400	--	--	
	21-25	26	6,000	156,000	11	0	100	11	17,160	--	--	
	26&Up	13	12,000	156,000	10	0	100	10	15,600	--	--	
Cruisers	21-30	32	8,300	265,600	9	0	100	9	23,900	12	11	2,630
	31-40	26	21,000	546,000	8	0	100	8	43,680	16	20	8,740
	41-50	26	45,000	1,170,000	8	0	100	8	93,600	24	18	16,850
	51&Up	13	110,500	1,436,500	7	0	100	7	100,560	36	28	28,160
Aux. Sail	15-20	7	2,600	18,200	9	0	100	9	1,640	--	--	--
	21-30	13	7,300	94,900	8	0	100	8	7,590	6	5	380
	31-40	13	21,000	273,000	8	0	100	8	21,840	16	12	2,620
	41&Up	7	36,000	252,000	7	0	100	7	17,640	20	15	3,530
Sailboats	8-15	6	1,200	7,200	12	0	100	12	860	--	--	--
	16-20	19	2,100	39,900	12	0	100	12	4,790	--	--	--
	21-25	19	3,000	57,000	11	0	100	11	6,270	6	5	310
	26&UP	7	4,000	28,000	10	0	100	10	2,800	16	12	340
TOTALS		650		\$5,800,500					\$526,400			-\$63,560
\$526,400 - \$63,560 = \$462,840												
New Boats With Improvement = (\$462,840 x 0.336) = \$155,500												
New Boat Growth Without Improvement = 29,000												
ANNUAL BENEFIT												\$126,500

TABLE 4 BENEFITS TO RECREATIONAL BOATING

Transient Boats (Equivalent)

HARBOR: Popponeset Bay

TYPE OF CRAFT	LENGTH (feet)	No. of Boats	DEPRECIATED VALUE		PERCENT RETURN			VALUE \$	
			AVERAGE	TOTAL	Ideal	% of Ideal	Gain		
			\$	\$		Pres.	Fut.		
<u>RECREATIONAL FLEET</u>									
Outboards	15-20	2	2,400	4,800	14	70	100	4.2	201
Inboards	15-20	1	4,500	4,500	12	70	100	3.6	162
	21-30	2	6,300	12,600	11	60	100	4.4	554
	31&UP	2	18,000	36,000	10	60	100	4.0	1440
Sterndrive	15-20	1	3,750	3,750	12	75	100	3.0	113
	21-25	2	6,000	12,000	11	70	100	3.3	396
Cruisers	21-30	1	8,300	8,300	9	60	100	3.6	299
	31-40	2	21,000	21,000	8	60	100	3.2	672
	41-50	1	45,000	45,000	8	60	100	3.2	1,440
Aux. Sail	15-20	1	2,600	2,600	9	80	100	1.8	47
	21-30	1	7,300	7,300	8	70	100	2.4	175
	31-40	1	21,000	21,000	8	60	100	3.2	672
Sailboat	8-15	1	1,200	1,200	12	80	100	2.4	29
	16-20	1	2,100	2,100	12	70	100	3.6	76
	21-25	1	3,000	3,000	11	70	100	3.3	99
TOTALS		20		\$185,150					\$6,375

ANNUAL BENEFIT = SAY \$6,400

6. Protection Against Offshore Emergencies

During sudden and prolonged storms at sea, recreational boats cruising in Nantucket Sound will often need a protected refuge where they may wait out the storm. With the proposed improvements, Poppo-nesset Bay would be a conveniently located refuge. Annual benefits accruing to this item is estimated to be about \$5,000.

b. Recreational Fishing - The U.S. Fish and Wildlife Service is not in favor of dredging the bay, as there would be a loss to the water fowl habitat if channels and anchorages were provided as planned. They estimate that the proposed jetties would provide 33,000 fisherman days, per year, if public access, safe walkways and parking spaces for cars are provided, for an estimated average annual benefit of \$49,500. The estimate does not reflect the cost of land purchase, road and parking lot construction, jetty modification or annual operation and maintenance. Their full report is included in APPENDIX A. Since the jetties would be on land, which is a private recreational beach, it is unlikely that the owners would consent to public parking areas and trespassing; therefore, annual benefits are not included in the overall benefits. Recreational sport fishing from private or charter boats is included in recreational boating in accordance with Corps directives. Surf fishing is not actively pursued in this highly residential area.

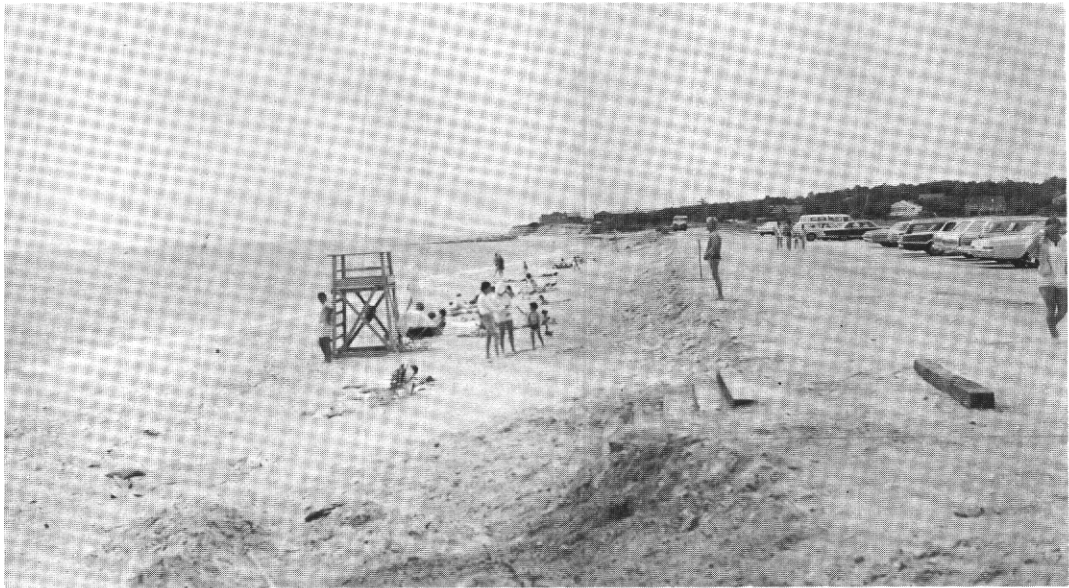
c. Recreational Beach Benefits - The entire beach is privately owned and not open to the general public, therefore, no general beach benefits can be claimed from the improvement. Depositing the dredged sand on the beach would reduce the overall cost of dredging and also reinforce the barrier beach, resulting in a collateral benefit only. Local interests, however, would probably require some adjustment from the owners of the beach to help defray the local costs of the overall cost.

SUMMARY OF ANNUAL BENEFITS

<u>Source</u>	<u>General</u>	<u>Local</u>	<u>Total</u>
Transferred boats	\$ 1,300	\$ 1,300	\$ 2,600
Existing boats	10,250	10,250	20,500
New Boats	63,250	63,250	126,500
Transient Equivalent	3,200	3,200	6,400
Reduction of Boat Damages	1,000	1,000	2,000
Off-shore Emergencies	<u>2,500</u>	<u>2,500</u>	<u>5,000</u>
TOTAL BENEFITS	\$ 81,500	\$81,500	\$163,000

COMPARISON OF BENEFITS TO COST

34. The annual benefits at \$163,000 and annual carrying charges of \$411,000 results in a benefit cost ratio of 0.4 to 1.0.



POPPONESSET BEACH - July 1969, Looking
southwesterly. Narrowing of private
beach by continual wave erosion.

PROPOSED LOCAL COOPERATION

35. The benefits to be derived from this proposed navigation improvements in Popponesset Bay are entirely recreational in nature. Local interest would be required to:

- a. Contribute 50 percent of the first cost of construction of the Federal project, presently estimated to be \$2,270,000.
- b. Provide without cost to the United States all lands, easements and rights of way necessary for the construction and subsequent maintenance of the project when and as required.
- c. Provide public access and public landings in the vicinity of each anchorage open to all on equal terms.
- d. Provide subsequent maintenance of the project exclusive of aids to navigation presently estimated to be \$133,000 annually.
- e. Regulate the use, growth and development of the harbor facilities with the understanding that they will be open to all on equal terms.
- f. Hold and save the United States free from damage which may result from construction of the project

36. Local interest have been informed of the results of the study and are in agreement with the findings. Letters from both towns are included in APPENDIX A.

APPORTIONMENT OF COSTS AMONG INTERESTS

37. Benefits that would result from improvement of Popponesset Bay are considered to be 50 percent general and 50 percent local in nature, as only recreational interests would benefit. The first cost of construction for the inlet jetties, groins and initial dredging would be divided equally between the Federal government and local interests. The apportionment is as follows:

FEDERAL INVESTMENT

Corps of Engineers 50% of 4,540,000	=	\$2,270,000
U.S. Coast Guard, aids-to-navigation	=	<u>20,000</u>
Total Federal Cost		\$2,290,000 (1)

NON-FEDERAL INVESTMENT

Cash contribution - 50% of \$4,540,000	=	\$2,270,000
Public landings (self liquidating)	=	<u>40,000</u>
Total Non-Federal Cost		\$2,310,000 (2)

(1) Excludes \$70,000 for Federal study costs.

(2) Excludes cost of lands, easements and rights of way.

COORDINATION WITH OTHER AGENCIES

38. All interested Federal, state and local agencies were notified of the public hearing on 21 May 1969 and were consulted during the course of the study. The Popponesset Bay Waterways Committee provided considerable data and assistance for the report.

DISCUSSIONS

39. Popponesset Bay is located on the south shore of Cape Cod in the towns of Barnstable and Mashpee, Massachusetts. A large shifting and unstable sandspit extends across the entrance of the bay. Numerous sand bars and shallow natural interior channels prevent normal usage of the bay for recreational boating.

40. The Popponesset Bay Waterways Committee presented a plan of improvement for the bay at the public hearing on 21 May 1969. The plan was opposed by many residents in the immediate area and was impracticable for small sail boats using the waterway without auxilliary power. A plan with a shorter barrier beach

and a straight entrance channel directly into Popponesset Bay was considered and selected as the most advantageous plan for navigation improvements and needs of local interests.

41. The results of the study were discussed with local interests at a meeting in Mashpee, Massachusetts on 10 February 1972. A representative of the local Congressman attended as well as officials of the State Division of Waterways, the towns of Barnstable and Mashpee, Massachusetts Audubon Society, other officials of the towns, and a number of interested residents. The Popponesset Bay Waterways Committee was well represented. While these representatives were not pleased with the findings, they did fully grasp the economic situation in trying to justify the plans considered. They also indicated that they would seek Congressional assistance in securing legislation that would allow the Corps to participate in the protection of shorefront areas which have private property abutting. Letters from the towns, indicating awareness of the findings, have been received and are part of this report.

CONCLUSIONS

42. The Division Engineer has considered all the desires and requests of local interests and finds that there is a need for recreational boating improvements in Popponesset Bay. He concludes that the plan most advantageous to the needs of local interests would be PLAN B, as described in the Plan of Improvement. However, the annual cost of the plan far exceeds the anticipated benefits and therefore cannot be economically justified.

RECOMMENDATIONS

43. The Division Engineer recommends that no Federal recreational navigation improvements be undertaken in Popponesset Bay at this time.

FRANK P. BANE
Colonel, Corps of Engineers
Division Engineer

4 Incl

1. Maps - 2 Plates
2. Appendix A
3. Appendix B
4. Supplement - SR - 148



ACKNOWLEDGEMENT AND IDENTIFICATION OF PERSONNEL

1. This report was made under the direction of:

Frank B. Bane, Colonel, Corps of Engineers, Division Engineer
John Wm. Leslie, Chief, Engineering Division
Joseph L. Ignazio, Chief, Planning Branch

2. It was completed under the supervision of Oscar E. Arpin, Chief Coastal Development Section and developed by Steven Onysko, P.E., Project Engineer.
3. The New England Division is appreciative of the cooperation rendered in connection with this study by other Federal and State agencies, municipalities, committies and individuals, particularly the following:

United States Fish and Wildlife Service
Massachusetts Division of Waterways
Selectmen, Town of Mashpee
Selectment, Town of Barnstable
Popponesset Bay Waterways Commissions
Maspee and Barnstable Harbormasters
Mr. Howard A. Rohdin
Mr. Charles N. Savery, P.E.

APPENDIX A

COMMENTS OF OTHER AGENCIES



UNITED STATES
DEPARTMENT OF THE INTERIOR
FISH AND WILDLIFE SERVICE
BUREAU OF SPORT FISHERIES AND WILDLIFE

U. S. POST OFFICE AND COURTHOUSE
BOSTON, MASSACHUSETTS 02109

March 10, 1972

Division Engineer
New England Division
U. S. Army Corps of Engineers
424 Trapelo Road
Waltham, Massachusetts 02154

Dear Sir:

This is our conservation and development report on navigation improvements being considered for Popponesset Bay, Barnstable County, Massachusetts. Your study is authorized by Section 107 of the River and Harbor Act of 1960, as amended. This report was prepared under authority of the Fish and Wildlife Coordination Act (48 Stat. 401, as amended; U.S.C. 661-666 inc.), in cooperation with the Massachusetts Divisions of Marine Fisheries and Fish and Game. It has also been coordinated with the National Marine Fisheries Service and has the concurrence of these agencies as indicated by letters dated February 29 and March 1, 1972, respectively.

Popponesset Bay covers approximately 668 acres and at mean low water is less than three feet deep in most places. Fresh water enters the bay from the Santuit, Mashpee and Old Quaker Run rivers. The mouth of the bay is partly closed by Popponesset Beach, a narrow sand spit protruding across the mouth of the bay. More than 220 shallow draft boats are based in the bay.

American peregrine falcons are present on the Cape in small numbers as spring and fall migrants. A confirmed sighting of the much rarer Eskimo curlew has been made at Plymouth Beach, less than 30 miles from Popponesset Bay. Both species are listed as Endangered Species in Appendix D, United States List of Endangered Native Fish and Wildlife (F.R. Doc. 70-13735 - Oct. 13, 1970). Both species are dependent upon habitat such as that provided by Popponesset Bay.

We understand that you are considering (1) restoring and rebuilding Popponesset Beach to high ground at Meadow Point; (2) dredging a 100-foot wide navigation channel to six feet below MLW ¹/ through Popponesset Bay and Popponesset Beach to deep water in Nantucket Sound; (3) constructing two parallel jetties seaward off Popponesset Beach to protect the new inlet; the south jetty extending about 1200 feet into the Sound and the north jetty extending about 500 feet; (4) dredging to six feet below mean low water, five anchorage sites totaling 46 acres. Approximately 85 acres of bay bottom presently less than four feet deep at MLW will be dredged. This is about 13 percent of the 668 acre bay and is significant particularly from a waterfowl habitat viewpoint.

Popponesset Bay is of value to forage and game fish species and also supports moderate populations of shellfish resources. The entire bay is productive and a successful oyster stocking program is being maintained by the Town of Mashpee. The bay's shellfish productivity is attributed to the quantity and quality of incoming fresh water, suitable depths, and good bottom material.

Shellfishing is a popular and valuable activity in the area. At least 1,200 resident family, non-resident, and commercial licenses were issued in the Towns of Mashpee and Barnstable in 1970. Their reported take for 1970 was approximately 16,000 bushels of soft clam, quahog, bay scallop, oyster and razor clam. Your letter of July 30, 1969 indicated that in 1968-1969, six to seven men collectively earned \$15,000 to \$20,000 for the sale of littleneck clams and ten to fifteen men collectively earned \$40,000 to \$50,000 from scallops taken from the bay. Your letter also states that when scallops are plentiful it is not uncommon for the annual take to be worth \$80,000 to \$100,000. (These data were reported by a commercial fisherman).

Channel and anchorage development will not directly affect the soft clams of the intertidal zone, but approximately 85 acres of oyster, quahog, and bay scallop habitat will be dredged.

We anticipate that within five years these species will be re-established in harvestable size and numbers, provided suitable bottom occurs at the 6' to 7' depth.

The proposed dredging of Popponesset Bay to accommodate more and deeper draft boats will increase the probability of petroleum spills, littering and associated human degradation of the environment. Petroleum spills in particular can adversely affect shellfish on a chronic or intermittent basis depending on the severity and duration of the pollution. The presence of more and deeper draft boats will also result in increased disturbances to waterfowl. In addition, waterfowl, like shellfish, are extremely vulnerable to harm from petroleum in water.

The proposed jetties can provide fishing opportunity for shore-based fishermen if public access, safe walkways, and parking spaces for ten cars are provided. We estimate average annual use of the jetties will be 33,000 fisherman days per year with an estimated average annual benefit of \$49,500.

Several species of songbirds inhabit the periphery of the bay and the intertidal zone is a feeding area for shore birds, wading birds, and waterfowl. The bay is heavily used by feeding waterfowl. Use is primarily by black duck, scaups, and Canada geese. Occasionally, swans feed in the bay. Waterfowl nesting habitat is scant.

The dredging will increase the depth of approximately 85 acres of bay bottom which is presently four feet deep or less. This will place benthic organisms beyond the reach of dabbling ducks on at least 13 percent of the bottom feeding area now available to them. This is a significant loss, and would be another in the long series of piecemeal waterfowl habitat losses that has reached the level of national concern.

The American peregrine falcon and Eskimo curlew, both Endangered Species, will not be directly harmed by the proposed action. Indirect harm could result if degradation of the bay reduces their food supply or makes the bay unappealing to them due to increased boating and other human activities.

We suggest that you incorporate the following information into your

draft environmental statement when it is prepared:

1. Environmental Setting Without the Project

Popponesset Bay has an area of approximately 668 acres and at mean low water is less than three feet deep in most places. The Santuit, Mashpee, and Old Quaker Run rivers flow into the bay. The mouth of the bay is partly closed by Popponesset Beach, a narrow sand spit protruding across the mouth of the bay. More than 220 shallow draft boats are based in the bay. The bay is of high value to forage and game species of finfish and moderate value to shellfish. The entire bay produces shellfish, which are harvested commercially and for pleasure. The shore of the bay is inhabited by songbirds and the intertidal zone is a feeding area for shore birds, wading birds, waterfowl and other species. The open water area provides a large expanse of shallow water for feeding waterfowl. Dabbling ducks, diving ducks, geese, and occasionally swans feed in the bay. There is limited black duck and mallard nesting activity.

2. Environmental Impact of the Proposed Action

Shellfish of the intertidal zone will not be directly harmed by the project, but the possibility of losses from increased pollution, particularly petroleum pollution from increased boating, does exist.

The proposed jetties will cover a small area of the bottom immediately offshore, but the effect will be insignificant and the jetties will be attractive to fish and can provide shore-based sport fishing.

Approximately 13 percent of the bay will be dredged, adversely affecting quahog and bay scallop resources, and reducing the bay's waterfowl habitat value by a like amount. The adverse effect on the quahog and bay scallop resource may only be temporary. Deeper water may provide these species with a more protective habitat. This bay,

however, having large populations of eelgrass and algae, certain anchorages may, in a few years, become catch-alls for decaying plant material. The greater potential pollution with increased use should not be understated.

The American peregrine falcon and Eskimo curlew, both Endangered Species, will not be directly harmed by the proposed action. Indirect harm could result if degradation of the bay reduces their food supply or makes the bay unappealing to them due to increased boating and other human activities.

3. Any Adverse Environmental Effects Which Cannot be Avoided Should the Project be Implemented

The loss of approximately 85 acres of shallow waterfowl feeding area is an irreversible and irretrievable loss.

This project has potential for benefit to sport fishing, but because of substantial waterfowl feeding habitat destruction and potential harm to species of the inter-tidal zone and the bay itself, we feel the overall value to fish and wildlife would be negative.

We recommend that the bay not be dredged as planned.

We appreciate this opportunity to report on the subject proposals. Please keep us advised of any changes in the project plans, including spoil site selection, so that we may conduct any necessary fish and wildlife studies.

Sincerely yours,

Willard M. Spaulding Jr.
Acting Regional Director



Town of Mashpee

SELECTMEN'S OFFICE

428-6805

FRANK E. HICKS
477-9565

KEVIN D. O'CONNELL
548-9461

GEORGE A. BENWAY
775-0505

Mashpee, Mass.,March 1, 1972

Col. Frank P. Bane
Division Engineer
Corps of Engineers
424 Trapelo Rd.
Waltham, Mass.

Dear Col. Bane:

This is to certify that this Board has reviewed the results of a study made of Popponesset Bay with Mr. Steve Onysko on Thursday February 10th at the New Seabury Country Club in Mashpee.

The report was adverse as it is not economically feasible for the Town to enter into a project of this magnitude at this time.

We agree with the results of this report, and it is our hope that at some future date this project may be more feasible from an economic standpoint with the Town, County, and Federal Government.

Very truly yours,

Frank E. Hicks
Frank E. Hicks, Chmn

Kevin D. O'Connell
Kevin D. O'Connell

George A. Benway, Jr.
George A. Benway, Jr.

BOARD OF SELECTMEN

BS:h



*Town of Barnstable
Selectmen's Office*

Hyannis, Mass. 02601

E. THOMAS MURPHY, CHAIRMAN

GEORGE L. CROSS

MARTIN E. HOXIE

February 15, 1972

Col. Frank Bane
U. S. Army Corp of Engineers
424 Priscilla Road
Waltham, Massachusetts

Dear Col. Bane:

This is to inform you that the Board of Selectmen from Barnstable on last Thursday attended a meeting held before representatives from your Department.

They explained to us very fully the situation concerning Popponessett Bay dredging and improvements and the reasons why no federal money could be used for these purposes at this time.

This is to advise you that we understand why this project is not attainable with federal money under the present federal legislation and rules of your Department. We do hope that sometime in the future conditions will be such that the matter can be undertaken by the Corp of Engineers.

Respectfully yours,

E. Thomas Murphy
E. Thomas Murphy, Chairman
Board of Selectmen

ETM/gcn

17 FEB 1972

APPENDIX B

ALTERNATIVE PLAN

APPENDIX B
ALTERNATIVE PLAN
PLAN A

1. This plan was suggested by the Popponesset Bay Waterways Committee, and is briefly described in paragraph 24 of the text. The details are shown on PLATE B-1 The cost estimate and economics are as follows:

A. PROJECT COST

Dredging

Sand	550,000	cy @ \$3.00	\$ 1,650,000
Mud	280,000	cy @ 4.50	1,260,000

Fill

Sand Dike	400,000	cy L.S.	20,000
Excess Sand, place on beach	150,000	cy no charge	

Rock

Grains	16,500	tons @ \$25.00	412,000
Jetties	16,000	tons @ \$25.00	400,000

Dune Grass

Planting on Sand Dike,	
30 acres @ \$2,000	60,000
	<u>\$ 3,802,000</u>
Contingencies	570,000
	<u>\$ 4,372,000</u>
Engineering Design	262,000
	<u>\$ 4,634,000</u>
Supervision & Administration	366,000
TOTAL FIRST COST	<u>\$ 5,000,000</u>
Navigation Aids (USCG)(estimated)	20,000
Public Landing 6 (estimated)	
Self Liquidating	40,000
TOTAL PROJECT COST	<u>\$ 5,060,000 (1)</u>

(1) Excludes \$70,000 for Federal study costs.

B. ANNUAL CHARGES

1. Federal

Corps of Engineers

I & A (50% of 1st cost) $\$2,500,000 \times .5798 = \$145,000$

U.S. Coast Guard

Aides to Navigation	$\$20,000 \times .5798$	=	12,000
M & O (estimated)			<u>2,000</u>

TOTAL FEDERAL CHARGES \$ 159,000

2. Non-Federal

I & A (50% of 1st Cost) $\$2,500,000 \times .5798 = \$145,000$

Maintenance

Dredging 31,000 cy @ \$4.00	=	124,000
Rock Jettie & grains 400 tons @ \$35.00	=	14,000
Sand Dike, grade & shape L.S.	=	<u>2,000</u>

TOTAL NON-FEDERAL CHARGES \$ 285,000 (1)

TOTAL FEDERAL & NON-FEDERAL CHARGES \$444,000

(1) Does not include annual charges for cost of public landings and other local costs that are self liquidating.

C. ANNUAL BENEFITS

Same as PLAN B, see paragraph 33 in text \$ 163,000

TOTAL ANNUAL BENEFITS \$ 163,000

D. BENEFIT-COST RATIO

B. C. Ratio = $\frac{163,000}{444,000} = 0.37$



SUPPLEMENT

ADDITIONAL INFORMATION CALLED FOR BY

SENATE RESOLUTION 148, 85th CONGRESS 1st SESSION

SURVEY REPORT OF POPPONNESSET BAY

MASHPEE AND BARNSTABLE, MASSACHUSETTS

Information Required by Senate Resolution 148, 85th Congress,
Adopted 28 January 1958.

1. Navigation Problems. Popponneset Bay is a shallow salt water lagoon within the town limits of Mashpee and Barnstable, Massachusetts on the southerly shore of the arm of Cape Cod. The low barrier beach fronting the lagoon is rapidly eroding by wave forces from Nantucket Sound and the Atlantic Ocean. The natural, uncontrolled inlet at the northeasterly end of the barrier beach is continually shifting and shoaling and precludes safe boat passage at low stages of the tide.
2. Other navigation difficulties are shallow depths throughout the bay, lack of anchorage areas, inadequate supporting shore facilities and the low, fixed highway bridge connecting Popponneset Island to the mainland.
3. Improvements Considered. Two plans of improvement were considered. They both included a stabilized inlet, an entrance channel, interior navigation channels, anchorage areas and barrier beach restoration. The shorter and least expensive plan, with the entrance directly into the bay, was selected as being more practical to the needs at local interests.
4. Discussion. The navigation study revealed the need for present and future recreational boating improvements in Popponneset Bay. However, the estimated cost exceeded the anticipated benefits and the plan was not economically justified. Therefore, the Division Engineer recommends that no recreational navigation improvements be undertaken in Popponneset Bay at this time.